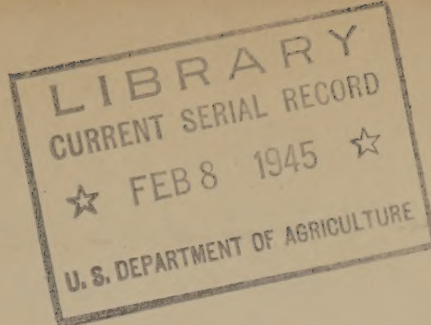


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Farm Work Simplification

REPORT OF
ACTIVITIES,
RESULTS, AND
AVAILABLE
MATERIALS

UNITED STATES DEPARTMENT OF AGRICULTURE
EXTENSION SERVICE - WAR FOOD ADMINISTRATION
EXTENSION FARM LABOR CIRCULAR NO. 21 - DECEMBER 1944

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FARM WORK SIMPLIFICATION ^{1/}

Activities, Results, and Available Materials

FOREWORD

A shortage of labor has been one of the most acute problems of farmers during 1943 and 1944. At the same time farm machinery has been rationed and difficult to obtain. It was therefore a major concern of farmers to find ways to increase efficiency of existing farm labor and to train large numbers of inexperienced workers. To assist them in meeting this situation, attention was turned to the contribution that might be made by applying to agriculture some of the work-simplification methods successfully used in industry.

This report is designed to present what has been done by the agricultural colleges in the field of work simplification, and what is available as a result of such work. The report was requested by the Land-Grant College--Department of Agriculture Committee on Training for Government Service. It is based largely on information obtained from a survey of the States made in September 1944 and on the reports given by the representatives of 12 of the State colleges of agriculture at a conference held at Purdue University, October 4 to 6, 1944. It is supplemented by additional information known to the authors as a result of their familiarity with the work under way in the various States.

It is recognized that this work represents only a portion of the many related activities that have contributed to a better utilization of farm labor during the war-time period. However, the newness of much of this work, and the permanent, as well as wartime values that may attach to the increases in efficiency resulting from this approach justify its treatment as a separate subject.

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DEVELOPMENT OF THE WORK

The Need for Work Simplification

Agriculture has gone through a long process of labor saving. It is generally recognized that greater "output per worker" over a period of years has been largely the result of changes in the size of business, higher yields, more mechanization, and better organization. On the other hand, many of the variations in labor accomplishment that exist between individual farmers working under similar conditions cannot be explained by these factors.

Industry has also gone through a long process of labor saving in much the same way. However, beginning with the pioneer work of Frederick W. Taylor, techniques have been developed in industry which increase productivity by concentrating on improvement of the operations of the individual worker and the lay-out of a job, without introducing major changes in the type of machinery used or the general level of technological development. This approach is valuable at all times as a means of increasing output. It becomes increasingly important in time of war when there is the greatest demand for products and the least possibility of obtaining additional labor or new machinery.

Though this approach has led to astonishing results in factories, it has been tried but very little on farms. In the late 1920's, during a period of relatively high labor costs, the New England States introduced time and motion techniques into their analysis of dairy-barn chores, the production of vegetables, and the harvesting of other crops requiring crews of workers for short periods, such as hay and corn silage. The results of these studies were important in suggesting how a farmer might improve his own way of doing these various farm jobs under the conditions on his farm.

A similar need for assistance of this kind has prevailed in the 1940's. It was desirable to supplement the general information on why one farmer was more efficient than another with more specific information as to how any farmer might improve his own efficiency under the conditions existing on his own farm. Attention was therefore focused on getting more information on the details of work methods, and the ways in which farmers learn new methods and put them into practice.

Work Simplification Defined

With this background in mind farm work simplification may be defined as a scientific, systematic analysis of ways of doing work in order to:

1. Eliminate all unnecessary work.
2. Determine the easiest, most effective method and sequence for performing the necessary work.

3. Determine the most convenient and economical kind and combination of equipment and facilities needed for effective job performance.
4. Standardize, insofar as possible, improved work methods and establish standards of performance as a guide to other workers.
5. Apply improved work methods, techniques, and standards of accomplishment by:
 - a. Preparing instructions on how to do certain jobs most effectively, demonstrating the influence of improved methods on production and fatigue.
 - b. Developing and teaching the general principles or guides which may point the way to improving the work methods used on any job.

The National Project

In order that there might be a headquarters for the general direction and coordination of the studies needed in farm work simplification, a grant of funds was made by the General Education Board. Dr. E. C. Young, dean of the graduate school, Purdue University, was named director of the national project. Purdue University accepted the grant of \$87,400 with the understanding that it would be used for the organization of research in farm work simplification on a cooperative basis in about 12 land-grant colleges throughout the United States.

The primary objective of the national project was to subject the work of agricultural laborers (their physical activity, work methods) to scientific study and analysis with the thought of developing improved, more effective ways of doing the many jobs associated with agricultural production.

It was the purpose, therefore, to:

1. Organize cooperative research projects with selected land-grant colleges jointly financed by the cooperating institution and the General Education Board funds.
2. Train experienced agricultural research and teaching personnel in work-simplification research methods with the assistance of industrial engineers.
3. Develop publications (films and literature) explaining the basic principles and objectives of work simplification as applied to agriculture.
4. Inform interested institutions and organizations of this new development and help put research findings in form for extension use.

5. Complete sufficient work-simplification research and teaching projects during the life of the General Education Board grant to encourage experiment stations and other research and educational institutions to continue such work after termination of outside financial support.

The national project was initiated in December 1942 and was to terminate July 1, 1944. In order to utilize fully unexpended balances, the General Education Board later extended the agreement to July 1, 1945.

Training of Research Workers

Because job-analysis studies were new to agriculture, it was necessary to give technical assistance to the organization of the State projects. To give training to the State project leaders as well as to bring together the different units of Purdue University which could contribute to this research, the Purdue Farm Work Simplification Laboratory was organized. This laboratory has no budget and is based on a cooperative agreement between the agricultural experiment station and the engineering experiment station.

Dr. Marvin E. Mundel, professor of industrial engineering, has carried much of the responsibility for the organization of the laboratory. Much of the project's activity at Purdue is centered in the engineering motion and time study laboratory. Dr. Mundel is in charge of the industrial motion and time study work and has had the principal responsibility for the training schools that have been held.

All the State project leaders have been given a 3-week training course in work simplification research and teaching techniques. Each cooperating institution has developed its own project after the project leader received the initial training. Though the national project services the State projects in any way possible, it exercises no supervision over the activities in the individual State once the project is under way.

The following is a list of major topics covered in the 3-week course. Instruction was given in lectures, laboratory work, and assigned readings. Full time during the 3-week period was devoted to this one course by those taking it.

1. Overview of motion and time study.
2. Outline and comparison of basic techniques.
3. Process charting.
4. Operation charting.
5. Micro-motion study.
6. Definition and recognition of therbligs.

7. Film analysis.
8. Simo charts.
9. Motion economy.
10. Stop-watch time study.
11. Rating and allowances.
12. Instruction sheets.
13. Multi-man and man and equipment charts.
14. Visual aids.
15. Review and integration of the field.

It was felt that the value of the research studies would be increased if extension workers could become more familiar with the methods used and principles involved in the work-simplification studies. A special 10-day course was given to a group of State extension workers in December 1943. This course was not so intensive as the one given to the research workers. It placed more emphasis on the training and educational phases of the work.

STUDIES IN FARM WORK SIMPLIFICATION

The purpose of this section of the report is to describe briefly the studies that have been made and the work now under way in the State colleges of agriculture. It covers work done during the present war period and the years immediately preceding it. It is not confined to studies made in cooperation with the national project, but New Hampshire and Massachusetts are the only States included which do not fall in that category. The study of dairy barn chores in Vermont was started prior to the national project.

Location of Studies

| <u>State</u> | <u>Commodities studied</u> |
|---------------|--|
| Colorado | onions, potatoes, sugar beets |
| Florida | beans, celery, potatoes, tomatoes, land clearing |
| Illinois | beef cattle, sweet corn |
| Indiana | hogs, poultry, tomatoes |
| Kentucky | tobacco |
| Massachusetts | celery, lettuce, tomatoes |
| Minnesota | dairy |
| Nebraska | hay |
| New Hampshire | dairy |
| New Jersey | potatoes, poultry |
| New York | apples, beans, corn silage, dairy, hay, potatoes, poultry, tomatoes |
| Oregon | beans, potatoes |
| Vermont | dairy, corn silage, hay |
| Washington | apples, barn arrangement |

The following review of activities is based on reports received from the States in response to the survey made in September. Results in terms of specific findings are not included, but a list of available publications is given at the end of the report. Many of the findings not reported elsewhere have been discussed in the "Work Simplification News Letter," issued periodically by the National Farm Work Simplification Project, Purdue University, West Lafayette, Ind.

It is only fair to say again that the items selected for inclusion in this report do not cover the vast amount of educational material on labor saving and training which has been issued in connection with the farm-labor program of the Extension Service. An attempt has been made to report only on the studies that have been made in job analysis and work simplification and on the materials that have been developed in connection with such studies.

Summary by Commodities

APPLES

Picking

Washington A method of study whereby details of picking methods could be recorded was worked out. Such details as the number of apples picked by each hand per second, the proportion of them that were doubles and singles, and the extent to which stems were pulled were observed and recorded. The picking process was broken into seven operations. Each of these was timed, and the influence of the method of performing each step was related to the picker's over-all output. Pickers studied ranged in output from 75 to 305 boxes a day.

As a result of this study several suggestions for picking more effectively have been made. Two major changes in equipment are recommended. A larger picking basket of lighter weight has been designed and will be tested during the 1944 season. Also a lighter-weight ladder which is more maneuverable is being constructed.

The suggested method of picking most effectively includes advice as to the size of container to be used, the method of working over a tree to reach all the fruit with a minimum number of ladder moves, location of empty boxes with respect to the tree, equal use of both hands, and rhythm in picking. A report on these findings is published in the Proceedings of the Washington State Horticultural Society for 1943.

Packing

Washington Time and methods studies were made in the packing plants during the 1943 harvest season. Considerable use was also made of motion-picture films. These films in turn were analyzed during the winter. Findings have not been published.

Brush removal

New York Fifty records were obtained from farmers by the use of the survey method to measure the saving in time through use of a brush pusher for orchard brush removal. Colored motion pictures were taken to show how these pushers operate and some of the salient points in their construction. A motion picture on this subject will be prepared for use in farmers' meetings during the winter of 1945.

BEANS, GREEN

Picking

Oregon After a study of methods used in picking pole beans, motion pictures were made of expert pickers in operation. A recommended method of picking is presented in the motion-picture film and in a film strip on the same subject.

Studies have also been made of the influence of various factors on the hourly and daily accomplishments of individual bean pickers. Based upon interviews with individual pickers and upon actual daily records, an analysis has been made of harvest labor efficiency with respect to several other important Willamette Valley crops which have heavy seasonal requirements for hand labor during the harvest period.

A manuscript on picking beans is in progress. It is entitled "Man Labor Requirements for Harvesting Pole Snap Beans in Oregon." The bulletin when published will discuss the influence of the following factors on the quantity of beans picked per picker per day: Age of picker, experience, length of picking day, sex, yield of beans per acre, supervision of pickers, and grower cooperation. A number of separate charts illustrating some of these relationships have already been released.

Florida Bean picking was studied in considerable detail, and a training film was made showing the methods used by expert pickers. The film has been used primarily to train inexperienced pickers.

New York A short training film was made for inexperienced bean pickers, based on pictures taken by the Florida project. Further study of picking methods in New York was made in 1944, and color motion pictures were taken for use in a training film on this subject to be made in 1945.

BEEF CATTLE

Feeding

Illinois Methods of preparing feed, distributing feed, and hauling and spreading manure have been studied on several farms in the principal cattle feeding areas of the State. Practical suggestions for improved arrangements of feed storage and feeding areas, and for labor-saving methods, have been worked out and discussed with the farm operators. A mimeographed report of the study has been the basis for discussion at special meetings of cattle feeders.

CELERY

Seedbed handling

Florida A study of methods of producing celery plants, a job which requires about 70 hours of man labor per acre of set celery, brought together a group of new and known labor-saving practices which should reduce time requirements by as much as 50 percent. This information was released in a motion picture entitled "Celery Seedbeds."

Pulling and setting plants

Florida Time and motion studies, including some motion-picture analysis, have been made of pulling and setting celery plants, but no publications or films have yet been released.

Harvesting and packing

Florida Nine major celery-producing organizations were studied during the 1944 season. Historical data were obtained by survey and were supplemented with observations and time studies of current operations. Each concern's labor input per unit of product for each step in the harvesting and packing operation was worked out. Reasons for variations in efficiency were isolated, and comparative achievements of the different organizations were discussed with foremen. Improvements suggested were then put into operation by the management. A bulletin describing the improved methods of harvesting and packing is in process of publication.

Massachusetts Time studies of packing-shed operations in preparing celery for market were made during the 1939 season, and the results were published in a mimeographed report No. FM 2. Diagrams were made of the arrangement of equipment and location of workers for each farm. On those farms where the work was slower and more difficult because of poor arrangement in the packing shed, diagrams were made of suggested changes for more efficient packing.

Tables were prepared showing the number of men working and boxes of celery packed on 16 farms in 1939. The method of handling the celery in the packing shed was described for each farm, and the reasons for a high or low rate of packing were given.

In 1940 when these farms were visited again, it was noted that modifications of the suggested improvements had been adopted in several packing sheds to increase the output per worker. Since much time is used in the field for harvesting celery, additional studies were made of field operations during the 1940 harvesting season.

The field operations that were timed and studied were: (1) Removing blanching paper, (2) cutting, (3) stripping, and (4) trimming the root. Different methods of doing these tasks are described and evaluated in mimeographed circular FM 7. A 450-foot 16 mm. film is available for use at farm meetings.

CORN FOR SILAGE

Harvesting

New York Detailed time studies have been made on the different methods of harvesting corn for silage. Loadometers were used to weigh the loads, so that an accurate measure could be made of the rate at which the corn was handled by

different methods. Results indicate considerable differences in labor requirements for the methods used. A motion picture entitled "Harvesting Corn for Silage" has been prepared, and a report is planned.

Vermont Using the careful analysis methods where the stop watch plays an extremely important part, Vermont is now studying ways of making silage. It is expected that a release will be prepared on this subject after the present harvest season.

CORN, SWEET

Harvesting

Illinois The job of snapping sweet corn for canning was studied in 1943 and 1944. Suggestions for making the job easier and faster were developed as an aid to training workers. Various methods of organizing workers have also been studied, with consideration of the problems of using crews of workers snapping into wagons and trucks. Observations have been made of snapping by machine -- a method that some canning companies have used to a considerable extent in 1944.

A mimeographed report covering the study in 1943 was distributed to all canning companies and to others who were interested. A brief publication illustrating the proper technique of hand snapping was distributed to workers in 1944. Motion pictures, from which a training film is being developed, were also shown at farm meetings.

DAIRY

Dairy barn chores

Vermont In the summer of 1942, Vermont began a study of labor efficiency in the dairy barn, using methods and procedures developed in industry. Briefly, the procedure consisted of an analysis of jobs performed, including a study of the time and motions involved in their performance.

Observations were made on 12 farms, where a complete record was made of all activities observed in connection with the chores within the dairy barn or in outbuildings or barnyard. The record included notations of distances traveled, time spent, tools used, location in which work was done, animals or equipment involved, and any other pertinent information.

After these observations had been made, the tentative conclusions as to how the dairy barn chores could be done more easily and more quickly were tested on a dairy farm selected at random. In this case study a detailed record was made of the time taken, the distances walked, and the routes traveled in doing the barn chores for a 22-cow dairy. Application of the principles to this test case resulted in a daily saving of 2 hours of time and more than 2 miles of travel. The

results are published in bulletin 503, "Labor Saving Through Farm Job Analysis."

In connection with the study of this farm a motion picture was made of the original and improved barn lay-out and work methods, entitled "Making Minutes Count." A series of leaflets dealing with specific phases of dairy chores was also planned. The first of these, "Save Work in Feeding Cows," has been published. A second leaflet on "Modern Milking Methods" is being prepared.

Another publication, "Labor Usage in Milking" by S. W. Williams, is planned for release at a later date. This publication will report on (1) machine time and amount of stripping in machine milking in 79 herds, including factors affecting them, and (2) variations in labor usage in milking operations in 19 machine-milked and 11 hand-milked herds.

Minnesota Farm work simplification studies were coordinated with the detailed farm accounting work that has been carried on at Minnesota for many years. Detailed farm-management accounts were kept with 24 to 27 farmers in south central Minnesota (Nicollet County) in 1941-42-43. Ten of these farms were selected for study in 1944. The detailed farm-management accounts were continued and the work simplification studies added. A route man lives in the community and visits the farms frequently. More than half of his time is devoted to work simplification.

Previous studies in this area and other areas provide over-all data on labor expenditures. The additional detail obtained in 1944 will make it possible to divide the total labor expenditure for a cow into the expenditures by jobs.

The farms, farmsteads, and important buildings have been measured and mapped. Detailed records of all chores on some farms and dairy chores on others have been obtained. The records include the nature of the task performed or movement made and the time required. These records, constituting process charts of the chores, have been studied to determine improved methods. Improvements in milking, feeding, and other operations have been made during the year.

In addition to numerous small improvements in methods and equipment, major remodeling of barns is being planned on two farms and is being tentatively considered on others. The detailed chore observations, providing data on the time required for each separate move, is being used to determine the probable time required and distance traveled in doing chores with each of several arrangements of the barn.

No comprehensive or special report on the project has been prepared. Three short articles have been released: "Save Time by Simplifying Work," and "Saving Labor in Milking," in Farm Business Notes; and "Reducing Labor Costs in Dairying," in Minnesota Farm and Home Science.

New York Detailed time and travel records were obtained on 17 dairy farms. Barn lay-outs, and the equipment and methods used, were also carefully noted. The chore routine was divided into a number of jobs, such as feeding grain, feeding silage, cleaning stables, so that the efficiency of the methods used for each job might be studied carefully. Preliminary tabulations show wide variations in time and travel for the different jobs between farms. Plans include a motion picture and leaflets based on the results of this study.

New Hampshire In 1941 a chore practice study was initiated jointly by the agricultural economics and dairy departments. Because of the developing labor shortage, it was thought that this labor efficiency project would make a more immediate contribution if the milking practice were given special emphasis in the first phase of the study. Milking practices were studied on 40 farms in 1943. The data indicated a wide variety of methods used and a wide range of time required. The lowest record of time the milking machines were left on cows was 3.5 minutes and the highest, 9.6 minutes.

Out of this background of local data, a procedure has been set up for developing 20 to 30 milking cooperators in each county to use as local demonstrators. This procedure has been intensively applied in Coos County and started in Grafton County. Considerable work is to be done at a later period in aiding these cooperators in better practices associated with milking.

HAY

Harvesting

Nebraska Major effort is being expended in observing and timing various methods of hay harvesting in common operation. Among the methods on which at least some observations have been made are pick-up baling, stacking with use of various types of buck rakes, use of overshot stackers and slide stackers, use of field choppers and stationary choppers, and dehydrating and sacking alfalfa cut green.

Data collected in the 1943 season were not adequate to give conclusive evidence on comparative time requirements of different complements of equipment or methods of working. Findings of the 1943 season were reported in Nebraska Extension Circular No. 875, entitled "Statistical Information of Labor Requirements for Hay Harvesting."

Further data on comparative time requirements are being collected this season, and motion pictures are being made of the most effective hay-harvesting methods observed. It is expected that innovations and improvements can be made on several of the common harvesting methods.

New York Detailed time studies have been made for two seasons on different methods of harvesting hay. Some of the results of the first season's study were reported in a four-page, illustrated leaflet entitled "The Buck Rake Saves Time and Effort in the Hay Field." A set of type A loadometers was borrowed from the New York State Highway Department to weigh the loads of hay. A motion picture entitled "Easier Ways To Make Good Hay" is being prepared from this study. Additional reports will be issued later.

Vermont Using the careful analysis methods where the stop watch plays an extremely important part, Vermont is now studying hay harvesting methods. A release is expected to be prepared on the subject after this harvest season.

HOGS

Production

Indiana It was recognized that labor represented a relatively small proportion of the total cost of pork production. This study was undertaken with the thought that if easy, effective ways of doing the various jobs involved in hog production could be worked out, a larger proportion of farmers would do these jobs properly.

Difficulties in doing the work of feeding and watering have frequently contributed to a break-down of swine sanitation programs. For this reason, five cases were selected for detailed study. Records on these farms, all well above average in work methods and in output per worker, were obtained in the form of motion pictures, process charts, operation charts, time and travel studies, and building and farmstead arrangement studies. With these records it was possible to establish time requirements for several systems of operation over an entire year and to check these labor requirements against results obtained.

Further suggestions for improved methods were obtained by visiting farms in addition to the five detailed case studies. From this study certain principles for using labor more effectively in producing pork were developed. A series of leaflets illustrating these principles is being prepared. Films taken in connection with this work have not yet been edited.

LETTUCE

Harvesting and packing

Massachusetts Field studies of methods of harvesting and packing iceberg lettuce were made on eight farms in the Dighton area of Bristol County during the 1940 season. The extreme variation in methods of cutting, packing, washing, and other operations is well illustrated by the fact that lettuce was not

handled in the same manner on any two farms. The chief differences found in the field operations of the growers were in the methods used in distributing crates or boxes, organization of the crews for cutting, and in packing. Time studies made of the different methods are reported in mimeographed FM 5.

ONIONS

Topping

Colorado Onion harvesting was studied in Texas in advance of the 1943 Colorado harvest. Skilled workers were timed, their methods described, and motion pictures made of their work methods. A 250-foot film showing the right and wrong way to top onions has been released. Additional studies will be made this fall, using micro-motion analysis and production records to provide material with which to revise and supplement this film before onion harvest in 1945.

POTATOES

Harvesting

Colorado Potato harvesting was studied in Texas in advance of the 1943 Colorado harvest. Skilled workers were timed, their methods described, and motion pictures were made of their work methods.

In Colorado field observations, including time studies and motion pictures, were made of picking potatoes by hand. This material was analyzed and good methods were worked out. These methods are being tested in the 1944 season.

Information on relative costs, output per worker, and influence on quality is being assembled on both mechanical and hand harvesting methods.

An illustrated pamphlet, Press Bulletin 98, "How To Pick More Potatoes," has been published. This bulletin shows the right and wrong way to pick potatoes.

A check list on how to pick potatoes was prepared and is in use in the field by foremen and potato pickers. Limited experience with this check list indicates that it will be very effective in improving the output of potato pickers.

Oregon Most of the work to date has been in making comparisons of the efficiency of various harvesting methods, both those in common use and methods involving the application of newer equipment. The place of potato bagging attachments used with diggers as well as other complements of machines is discussed in a recent mimeographed publication, "Potato Harvesting Methods in Oregon," Station Circular 345. Hand picking

methods are also described and data on use of the picking belt are presented. A motion picture dealing with the material described in this publication has been prepared.

It is expected that other special harvesting jobs will be given study and that the problem of moving potatoes to storage, sorting them, and preparing them for market will be given further analysis.

New Jersey Considerable time was spent in observing potato harvest methods in common use, and time and labor requirement studies and tabulations were made. Preliminary results of these observations were summarized in a mimeographed publication entitled "Potato Harvest Methods in New Jersey." It appeared from this study that while substantial improvements in hand harvest methods could be made, mechanical means of handling potatoes in bulk would eventually be developed.

Florida Time and motion studies, including some motion-picture analysis, have been made of harvesting potatoes, but no publications or films have yet been released.

Production and harvesting

New York In cooperation with vegetable crops specialists, an 800-foot 16 mm. film on effective methods of doing work associated with potato production was produced, entitled "More Potatoes With Less Help." This film stresses cultural practices as well as easy ways of performing the work. It presents the results of work simplification studies of potato cutting and of picking up potatoes and moving them to storage. Time requirements for different kinds of machines to do specific jobs are also given. Another motion picture was prepared to use in training inexperienced potato pickers, entitled "Pointers for Potato Pickers." A four-page illustrated leaflet was prepared on the same subject for distribution among potato pickers.

Cutting seed

Colorado Community mechanical cutters, as well as various hand cutting methods are under study. Use of a double-edged knife pre-positioned in a cutting board, a hand cutting method worked out by the project, materially speeds up hand cutting. A description of this method and of an improved mechanical cutter using a circular disk is being prepared for publication.

New Jersey A study of potato cutting methods was made at the request of several farmers. Some of the results of various means of hand and mechanical cutting were reported in a recent preliminary release and will later be available for general circulation.

POULTRY

Poultry chores

New York In cooperation with poultry extension workers, detailed time and travel studies have been made on several semicommercial poultry farms. The same procedure has been followed as in the dairy chore study. Even though the farms were very carefully selected on the basis of labor-saving methods that might be studied, extremely wide variations were found between farms in the amount of time and travel to do each of the jobs involved. Preliminary tabulations have been prepared, and a pictorial exhibit showing the travel involved in watering hens in different ways is being used in extension meetings. Plans include a motion picture and leaflets based on the results of this study.

New Jersey From a group of leading poultrymen several of the problems of poultry production and handling the laying flock were outlined, and solutions were suggested by fellow farmers as well as by the studies made of several jobs such as cleaning, candling, grading, and packing. Motion pictures were used to show job improvements and to encourage farmers to search out their own ways of improving their jobs.

Pullorum testing

Indiana Studies are now being made of the relative economy and effectiveness of different methods of selecting and pullorum-testing flocks. Approximately 16,000 Indiana farm poultry flocks producing hatchery eggs must be pullorum-tested annually. Present wide variations in processes and equipment used on this hard job indicate large opportunities for standardization on improved methods which will be developed and tested in this study.

Processing

Colorado It is contemplated that a study of turkey processing plants will be made this fall with a view to applying the principles of work simplification.

SUGAR BEETS

Topping

Colorado Work on the project was begun in September 1943. Field observations, including time studies and motion pictures, were made of topping sugar beets. This material was analyzed and good methods were worked out. These methods are being tested in the 1944 season.

Motion pictures showing the right and wrong ways of topping sugar beets are available for preliminary use in Colorado. At the close of

the season additional material will be available to complete this film, as well as a pamphlet on beet topping, and a check list.

Some study has been made of an easy way to shovel sugar beets, and it is expected that this work will be completed and results released by January 1, 1945.

TOBACCO

Production and harvesting

Kentucky

Virtually all of the work simplification research techniques were employed in studying the major operations involved in the production and harvest of tobacco. Stop watch studies, motion pictures, crew coordination studies, process charts, and operation charts, as well as man and machine charts, were used. Three men spent the entire 1943 season studying methods in different areas of the State. Methods which showed the least time requirement among those studied were taught to other workmen and such improvements as seemed desirable were introduced. The resulting work techniques or methods, after being tested, were described in a series of publications called "Easier Ways To Do Farm Work."

Leaflet 73, "Pulling Tobacco Plants," shows that one of the major improvements in method was the introduction of a plant-bed board which speeded up the pulling work and reduced the effort required. Ten guides are presented and illustrated which will save work in pulling plants.

Leaflet 75, "Machine Setting of Burley Tobacco," lists the 12 easiest and quickest ways to do the machine setting operation. Data show that 3 man hours per acre are saved by marking the rows, applying the fertilizer, and pulling the setter at the same time. Information in this leaflet is based upon detailed studies of 10 sample farms where the time required for setting an acre of tobacco ranged from 6 to 17 hours.

Processed Report W.S. 6, "Hand Setting Tobacco With Less Work," describes the easiest method of setting plants by hand where mechanical setters are not or cannot be used.

Leaflet 76, "Cutting and Spearing Tobacco," describes the time-saving way to perform this operation. It is based on careful study of the way 16 rather skilled operators performed the task. The leaflet gives a detailed description of the footwork, the equipment, and the movements which contribute to rhythm, speed, and ease in performing this rather difficult task.

Leaflet 79, "Cutting and Housing Burley Tobacco," is a 15-page leaflet offering suggestions about two methods of cutting and describing effective methods of piling and loading tobacco, hauling it, and getting it into the barn for curing. Special emphasis is given to organization of this task so that all members of a large crew can work continuously without delays or unequal distribution of work.

Leaflet 84, "Stripping Burley Tobacco," gives and illustrates 20 suggestions or guides to be followed in doing this job the time-saving way. It is based on careful study of 24 strippers observed during the 1943 season.

Leaflet 86, "Taking Down, Bulking, and Pressing Burley Tobacco," reports the best methods found for doing these operations. Well illustrated, this leaflet emphasizes placement and organization of the crew as well as equipment and work methods.

In addition to the leaflets, two motion pictures and film strips have been prepared. One film is entitled "Pulling Tobacco Plants" and the other "Harvesting Tobacco." Other motion pictures and film strips will be released to supplement the leaflet series.

TOMATOES

Picking for canning factory

Indiana In this study hand picking methods in popular use were studied and rates of production established for each method. Analysis of motion pictures of several pickers revealed that about 70 percent of the picking time was spent moving the hands between the hamper and tomato vine. Therefore, an improved method of picking was worked out in an effort to lower this as well as the over-all time requirement.

The improved method was tested in the field to establish rates of output which could be expected from its use. The rules to follow in using this method were published as Experiment Station Leaflet 298, "Making Movements Count in Picking Tomatoes." A 400-foot motion picture of the same title was released to help teach the improved picking method.

New York Results of the Indiana study on tomato harvesting were used in a leaflet which contained a color plate showing the U.S.D.A. grades for canning factory tomatoes, for distribution among tomato pickers. The Indiana film on picking tomatoes was adapted to New York conditions and used to train inexperienced workers in the State. Further studies of picking methods were made in 1944 and color motion pictures were taken to be used in a picture on this subject in 1945.

Picking, green wrap

Florida Time and motion studies, including some motion-picture analysis, have been made of picking tomatoes (green wrap), but no publications or films have yet been released.

Harvesting and packing market tomatoes

Massachusetts Tomatoes were grown by three different methods on vegetable farms that were studied in 1940: (1) Flat-type culture, (2) staked, and (3) trellis. Tomatoes were sold in the markets of the State in many different containers, such as the Boston splint basket, half-bushel and bushel boxes, and half-bushel hampers. Considerable difficulty was encountered in timing tomato picking because of the different sizes and types of containers used for picking and for marketing.

Three general packing methods were used; namely, packing directly from field boxes, packing from tables or trays where field boxes had been dumped, and packing from a belt operated in conjunction with a mechanical wiper.

The results of this study, including rates of picking and packing, methods of packing, and diagrams of packing sheds are reported in mimeographed FM 6. A 400-foot 16 mm. film is available for use at farm meetings.

Tying staked tomatoes

Florida In this study an improved knot and method of tying was worked out which enables five men to accomplish as much as was formerly accomplished by six using the old method. The improved method is shown by drawings and instructions in a poster entitled "Save Work - Save Time in Tying Stake Tomatoes."

Pruning

Florida Time and motion studies, including some motion-picture analysis, have been made of pruning tomatoes, but no publications or films have yet been released.

Peeling for canning

Indiana One of the bottleneck jobs in the tomato canning factory is the hand peeling of the fruit. At the request of the industry a study was made of peeling methods. Expert peelers performed before the motion-picture camera at a peeling belt set up in the laboratory in advance of the canning season. Wide variations in methods and accomplishments were found.

Good parts of several methods, along with innovations suggested from the study, were combined into a suggested new peeling method. This method is described in Experiment Station Miscellaneous Publication 23, "An Easy Way To Peel Canning Tomatoes."

Motion pictures showing this method have also been released. Peeling bosses are being instructed in the improved method in a series of schools this season.

Canning-factory operation

Indiana Labor requirements for different steps in the tomato canning process are being established for a 2-year period by survey. From a sample of 36 factories it is clear that wide variations in accomplishment exist. Further refinements of the time studies will be made during the canning season, and reasons for variation in accomplishment will be worked out. Work methods, flow of product, type of product, volume, plant lay-out, and equipment are among the factors that appear important.

LAND AND BUILDINGS

In addition to the studies of work methods in crop and livestock enterprises, some work has been started recently on lay-out and building arrangement.

Barn arrangement

Washington In advance of the harvesting season a study was made of several of the barns being used for general farming operations to ascertain the influence of arrangement on labor requirements. Also, the importance of farm and farmstead lay-out is being studied at the same time. It is expected that the barn-arrangement suggestions coming from this study will be incorporated into a newly constructed experimental building.

Clearing land

Florida A short film portraying the easier and more effective ways of clearing land in Florida was prepared and released at the request of a group of interested farmers and ranchers.

CONCLUSIONS AND GENERAL COMMENTS

In order that results from the studies in farm work simplification would be quickly available and readily usable with farm people the procedure followed has involved a close working relationship between research and extension. The chief objective of all projects was to make a contribution that would be helpful during the present period of short labor supply. A variety of approaches were used which have helped to clarify the application of motion and time study techniques to agriculture.

Several of the persons conducting these studies and doing educational work with farmers have made observations and drawn conclusions that may be helpful to others contemplating similar work. The opinions expressed are influenced by the type of work that was being studied and by the immediate objective of the project. Some studies were made on the general problem of farm chores and other occasional jobs and some on the repetitive operations connected with planting, harvesting, and packing. Some studies were designed to develop an improved method as a result of the analysis, and others were directed toward stimulating farmers to think through and work out their own improvements based on the ideas and principles learned from the analysis.

Motion and Time Study and the Hog Enterprise

Conclusions as to the adaptation of motion and time study to the hog enterprise have been made by J. W. Oberholtzer, Purdue University, as a result of his experiences on an intensive study of work methods on five Indiana hog farms.

Procedure followed in making the study:

1. Descriptive survey of how the work was done on five farms.
2. Observation of work as it was done, using camera, stop watch, process charts.
3. Final survey to fill in details on jobs not observed.
4. Comparison of methods and time requirements on the five farms.
5. Synthesis of the various methods under similar conditions.
6. Classification of the results under principles.
7. Checking of results with committees.

Conclusions as to the adaptation of motion and time study:

1. Exact outlines for doing all the work of the hog enterprise on all farms cannot be developed. However, principles of motion and time economy that will apply specifically to the hog enterprise may be developed.

2. For certain phases of the work rather definite recommendations may be made as to the methods to be followed for the most effective use of labor.
3. Analysis of processes is more applicable and will yield more worthwhile results than the detailed analysis of specific operations.
4. In process analysis the worker must depend more upon the collection of ideas from experienced operators as to the best method of doing a job than in the case of more detailed operation analysis.
5. The charting of operations accompanied by stop-watch readings is more useful than the study of motion-picture films to simplify small details.
6. Since labor is only a small part of the cost of hog production the interrelationship of labor with other factors cannot be neglected.

Suggested procedure for future studies of similar jobs:

1. Make a broad, descriptive survey of a large number of cases.
2. Make detailed observation of processes on farms where the survey shows that information can be obtained.
3. Develop the best methods.
4. Apply the best methods.

Comparative and Operational Approaches

The following excerpts were made from an informal paper presented by Max E. Brunk, University of Florida, at the Purdue conference of State project leaders, October 4 to 6, 1944.

The greatest progress in the Florida project has been made by first conducting a comparative study of a process, studying each operation on several farms, and then filling in the gaps with the operational or job approach. This serves two purposes:

1. It gains the confidence of the farmer.
2. It informs the researcher.

The operational or job approach (analyzing and improving a job on the spot without surveying other methods) definitely has its place, but its value increases greatly as the researcher learns more and more about a particular operation. This knowledge must come from many farmers, not just one. Also this information must be collected by actual observation and study, rather than by questioning a number of operators.

Some of the reasons why much more can be accomplished with the operational approach if it is preceded by a careful detailed comparative study of certain processes on a large number of farms are as follows:

1. An idea may be developed simplifying some job, only to be discarded later when it is found that another step in the process nullified its advantage.
2. Many farmers are doing the same jobs in different ways. We are not ready to contribute much until we have found the best methods already being used on farms. By using operational analyses we may develop many labor-saving ideas only later to discover these same or even superior methods already in use.
3. For a long time in Florida it was assumed that by selecting the most successful and progressive farmers we could observe the best-known work methods in operation. From this we would then make our study to find simplified work methods. Strangely, many methods found on these progressive farms were easy to improve. But when these improved methods were conveyed to another farm they frequently were not adaptable or were inferior to another method already in use. It was then realized that the best methods are not always, and sometimes never, found on the best farms.
4. There are many variables in agriculture within a single type of farming. For example, the conclusions of one study after a thorough investigation are interesting because they state that the hand-knife method of cutting celery is best for one area and the push-knife method is best for another area. The difference is due to size of crews, soils, and varieties. The conclusions go even further and say that for the same crew the hand-knife method may be best today, but the push-knife method may be best for tomorrow. Why? Because of temperature changes. Celery becomes brittle when it is cool and must be handled more carefully than when it is wilted.
5. Farmers have an uncanny ability to create reasons, both valid and invalid, why a method won't work. Many an idea has been presented, and we have accepted the farmer's reasons as to why it won't work, only to find that method in successful operation later. The important thing is not whether the farmer's reasons are valid or invalid, but whether you can show him the advantages and disadvantages of a method and to what extent one is better than another.

The procedure followed in the Vermont studies would support the conclusions drawn from the experiences in Florida. R. M. Carter is using a research technique consisting of roughly the following four steps:

1. The investigator becomes thoroughly familiar with the various methods employed to get a job done.

2. Common and promising methods are studied in full detail and improved where possible to arrive at factual conclusions as to their relative effectiveness.
3. Hypotheses, principles, and guides for effective performance of the particular job under study are drawn up from the research investigation.
4. These hypotheses are tested in experiments on actual farms.

In New York the comparative approach has been used almost exclusively. This has enabled New York to work on many commodities and to prepare the way for more detailed studies later. I. R. Bierly describes the approach as follows:

General observation early in the study indicated that there was a wide variation among farms in the way that individual operations as well as the major jobs were being performed. It also became evident early in the study that even close neighbors of those farmers who had developed improved and timesaving methods in doing a particular operation or job were not aware of these methods. Thus few were aware of the existence of improved methods, or of the possibility for using easier methods on their own or other farms.

The detailed time records further indicated that on each farm some parts of each job were carefully planned to save time and energy, while other parts of the same job were apparently done in a particular way only as a matter of habit and without careful planning to save time and energy. This situation was especially evident in the study of dairy-barn chores and poultry chores.

Because of these conclusions it was deemed desirable during the early stages of the development of the project, and especially for the purpose of getting some results that would be of value to farmers in New York State as soon as possible, to make careful time analyses of improved methods as they were found on actual farms, and to take motion and still pictures of them so that they might be explained and shown to other farmers. In general, farms studied were selected (after consultation with county agents) as among the most progressive farms in their communities.

At the same time, the investigator has kept in mind that there may be still better methods than those observed. Hence good methods observed may be further improved. As the project continues, more detailed job analyses will be made to attempt to develop some new time-saving techniques.

Because an individual farmer is just as much interested in having the job done correctly, and in having a good quality product to use or sell, as in doing the job efficiently, the work has been done in close cooperation with subject-matter specialists in other departments.

Summary of Research Objectives and Methods

The following comments, published in the October Work Simplification News Letter, were prepared by S. A. Engene, University of Minnesota, based on the reports made by the State project leaders attending the conference at Purdue University, October 4 to 6, 1944.

This summary brings together many of the related ideas discussed at the conference, evaluating the progress made and future possibilities in the field of farm work simplification.

Objectives of research -

(Listed in order of frequency with which they were mentioned.)

1. To find simplified ways for doing specific tasks. Jobs chosen for study apparently were bottleneck jobs.
2. To help determine a satisfactory procedure whereby individual farmers can analyze and simplify their own methods and to teach that method to farmers. New Jersey has done most in teaching farmers methods of self-analysis.
3. To determine general principles of motion economy that can serve as positive guides for farmers. (Industrial motion economy principles are often accepted as axioms rather than as principles to be tested.)

Evaluation of objectives -

1. Considerable progress has been made with intensive studies of highly repetitive operations, particularly on crops. Farmers apparently prefer to be given a ready-made method rather than to be taught to think for themselves. This can be done with studies of the type mentioned.
2. Because much of the work in livestock enterprises is miscellaneous in nature or is greatly influenced by more or less permanent features peculiar to each farm, it may be difficult to develop specific instructions for doing this type of farm work. This may necessitate training farmers to plan their own work methods.
3. Experience (as in Vermont and New Jersey) in teaching work-simplification analytical procedures to farmers indicates that progress can be made but that it is slow. Perhaps analysis methods should be simplified so that something less than 6 hours instruction would be required per person.
4. A series of positive principles of work simplification well thought out and adapted to farm conditions would be helpful to extension workers. Each project should formulate such a list for circulation and comments.

Most fruitful fields for investigation -

1. Work on intensive crops requiring hand labor yields results most quickly and probably nets the greatest accomplishment per unit of time spent in study. Class 1 (body motions) and class 2 (equipment) changes can be specific, easily taught, and broad in coverage. There is less opportunity in working with crop operations already mechanized.
2. Opportunities for labor saving in livestock production are large, but work simplification in the sense of strict motion economy yields limited results (except in repetitive jobs such as milking, egg handling, sheep shearing.) To make the savings which appear possible in livestock work two approaches appear possible: (a) teaching the farmer methods of self-analysis; and (b) study of farmstead and building arrangement and types and location of equipment.
3. Useful standards of labor performance could be developed and used in comparative analysis and as an opening wedge with farmers.
4. Study should be given to the dollar value of work simplification, especially when expenses are involved in making changes.

Methods of research -

1. Comparative analysis of various farms or other units is valuable if the difficulties of making comparable a series of observations on unlike farm situations can be overcome. Experience with the method and roughness of time and effort measurements also present problems.
2. A considerable part of the research must be done through analysis of individual operations--the "operational" approach. This method must supplement the comparative analysis to locate further refinements in methods. This approach must also be used by the individual farmer who has little opportunity to observe methods on other farms.

Other Contributions to Work Methods

Studies in farm work simplification invariably lead to suggestions that involve in many instances rather sweeping changes in practices, equipment, and building design. Such changes usually concern things which take several years to develop, but which in the long run offer much to improve work methods. They should not be overlooked in a scientific, systematic analysis of ways of doing farm work when considered in its broadest possibilities.

In connection with the potato studies, questions have been coming up in regard to further mechanization. The possibilities of bulk handling, harvesting machines with greater capacity, and the mechanical separation of potatoes from the vines have all been brought up for further analysis. Some of the studies have made a start toward analyzing hand and machine methods of cutting seed.

There is a great deal of interest in the snapping of sweet corn by machine. Though the development of a satisfactory machine is still in the experimental stage, considerable effort is being made in that direction. A number of machines are in use, and this trend is expected to proceed rapidly.

Studies are being made on the assumption that the conventional methods of housing dairy cows might be improved upon, and that consideration should be given to other methods of housing dairy cows. Some of these studies are set up to determine the relative advantages and disadvantages of the open-pen type of dairy barn with milking parlor, and the conventional insulated stall-type dairy barn.

Several electrical companies are planning work simplification studies of methods used on dairy and poultry farms. They hope, during the progress of such studies over a period of time, to find out how much saving in time and travel may be made by careful examination of the methods and equipment used. This work is being done to develop a better basis for the designing of equipment to be manufactured at a later date.

Much of the analysis work being done on haying operations has consisted more of a comparison of the rapid development of several new harvesting methods than of a study of improvements in any one method. This is necessary when changes are taking place as rapidly as they are in the job of putting up hay.

Many studies under way in the scientific laboratories of agricultural colleges are making big contributions to new work methods. The introduction of segmented beet seed has greatly changed the job of thinning sugar beets. The influence on milk production of a definite time interval for milking cows by machine has pointed toward the desirability of a shorter period, which in turn affects other jobs done in connection with dairy-barn chores. Tests are being made of chemicals to find an easier and cheaper way of removing potato tops in foundation seed plots and to determine the relative effectiveness of top killing and top pulling for the control of leaf-roll spread.

There are at least five classes of improvements which can be made in a job.

1. Physical work may be simplified and made easier through the use of easier motions, arrangement for less walking, stooping, carrying, etc.
2. Equipment may be relocated, redesigned, or new equipment and machinery may be added.
3. The whole process may be changed to alter the work pattern or sequence.
4. Raw materials such as feeds and fertilizers may be changed. This may involve departures from established farm practices.
5. The type, condition, or form of the finished product may be changed.

In the foregoing examples all five classes of job improvement have been mentioned. Primary emphasis has been given to class 1, 2, and 3 changes. Class 4 and 5 changes require more time, are more involved, and must be examined from all angles by several specialists. With the introduction of improved practices, new equipment, and changes in building arrangements, it is obvious that many factors involved call for a close working relationship of representatives from management, engineering, and the commodity involved. Interdepartmental cooperation, with a healthy appraisal of related recommendations, is essential to real progress in this field of work.

In concluding, we would like to express a hope that in the desire to move on into the bigger problems of agriculture, we do not overlook the many little things that help a farmer in his day-to-day operations. These have been the real contribution of the work simplification studies. The studies have filled a need that has existed for many years in the way of practical assistance to the individual farmer in how to be more effective in the performance of his daily routine of work. He will be interested in help of this kind for some time to come.

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